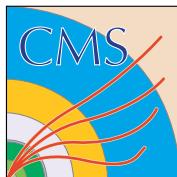


**PRS: Physics Reconstruction and Selection
HCAL/JetsMET group**

HCAL/JetMET Status #2

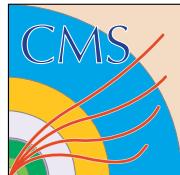
**Shuichi Kunori
U. of Maryland
08-Feb-2002**

**News
Simulation Group
Calibration & Monitoring Group**



CMS Week

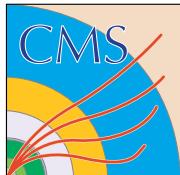
	PRS: HCAL/JetMET	Others
Mon 900-1030		HCAL PM
1100-1800		Plenary Opening
Tue 900-1030	Calib/Monit - simulation work - (Olga)	HCAL I&C, TRIG
1100-1230	Physics Obj (Sasha)	
1400-1600	PRS Muon	DAQ
1600-1800	PRS b/tau	
Wed 900-1000	Subgroup manager reproto (sk)	Physics
1030-1230	DCS-PRS joint -calibrarion- (Jim/Olga)	Physics
1400-1600	PRS e/gamma	HCAL Elec/DCS
1600-1800	PRS JetMET (sk)	HCAL IB
Thr 830-1230		Plenary
1400-1600	Software (Salavat/Sunanda)	FB/MB/CB
1600-1800	- open for working session -	
Fri 900-1230	Joint with Physics group (Sasha)	
1300-1400	Subgroup manager (closed) (sk)	
1400-1800	Joint with Physics group (Sasha)	CB



PRS Milestones for DAQ TDR HLT section

- ◆ Complete online selection for low-luminosity: Dec 2001
- ◆ Determination of calibration methods and samples: Mar 2002
- ◆ Data rates, data formats, online clustering: Mar 2002
- ◆ CPU analysis for low-luminosity selection: Mar 2002
- ◆ Complete online selection for high-luminosity: Jun 2002
- ◆ Repeat online selection for low-luminosity: Jun 2002
- ◆ CPU analysis of online selection: Jun 2002
- ◆ B physics results ($B_s \rightarrow J/\psi \phi$; $B_s \rightarrow D_{\star} \pi$): Jun 2002
- ◆ DAQ TDR ready (PRS part): Sep 2002
- ◆ L1: DAQ TDR submission (DAQ milestone) Nov 2002

New CMSIM/ORCA production is starting !
for 1E34 (and 2E33) with GCALOR
and a new tracker geometry.



ROOT

Event Database

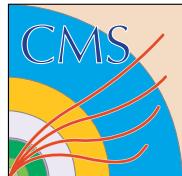
- CMS decided to move from Objectivity to ROOT/IO+ α .

Event Analysis Tool

- Lizard or ROOT
- Current JetMET analysis uses PAW/Ntuple
 - Problem with PAW/ntuple
 - Limited information (because of size limitation)
 - particles, towers, jets, met
 - Macro uses FORTRAN
 - Moving to ROOT
 - Possibility to add more information-
 - Tracks, e/ γ , muons, ...
 - C++ based
 - smaller file size by compression.

→ Jordan Damgov + Robert Lee, Hans Wenzel, Pal Hidas

- Step 1) Defining ROOT objects.
- Step 2) Implementation



Simulation group

(Sunanda Banerjee)

Full simulation

- CMSIM/OSCAR implementation
 - Geometry (Sunanda Banerjee)
 - Photon production & propagation (Sunanda Banerjee)
 - HB/HE/HO
 - HF shower library (Victor Kolosov)
- Verification
 - Tool - Standard histograms (Shashi Dugad)
 - Basic / advanced
 - Hadron Shower (Sudeshna Banerjee)

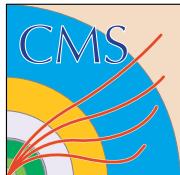
Fast simulation

- Calorimeter response (??? / Salavat / Pal)
- Physics objects – jets/met/tau (???)

Test beam simulation

- H2 PPP / Production wedges (Kajari Mazumdar)
- Hanging file

Simulation software/production support



Calibration & Monitoring group

(O.Kodolova)

Test Beam and initial energy scale

- Requirement for beam test / analysis / source

Response equalization (Uniformity + Dead Ch.)

- Source/min-bias/in-situ

Time Dependence

- Source/laser/LED/min-bias/in-situ

Data collection and maintenance

- Data type / Data format / file system / database

Software Tools

- ORCA Interface

JetMET energy scale

- MC study / In-situ calibration

Synchronization

A.Yershov
A.Gribushin
H.Budd, D.Karmgard
(HE) (HO)

A.Krokhotine
K.Teplov
???

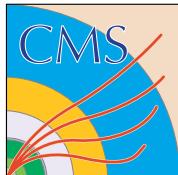
A.Gribushin
A.Yershov
(HB) (HE)(HO)

A.Oulianov
T.Kramer

A.Oulianov
S.Abdullin

I.Vardanyan
A.Kokhotine
P.Hidas
V.Konnopianikov
R.Vidal,

???



Calibration & Monitoring Scenario (HB/HE)

(same to HF)

1) Before megatile insertion

- megatile scanner: all tiles
- moving wire source: all tiles

2.1) After megatile insertion

- moving wire source: all tiles / 2 layer
- UV laser: 2 layers/wedge

2.2) After megatile insertion

- test beam: a few wedges.

Absolute calib.
Accuracy of 2%
for single particle

3) Before closing the CMS

- moving wire source: all tiles
- UV laser & blue LED: all RBX
(do 3, about once/year)

Monitor for change
with time
Accuracy < 1%

4) Beam off times

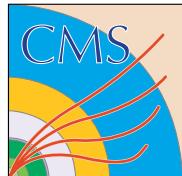
- moving wire source: 2layer/wedge
- UV laser: 2 layer/wedge
- UV laser & blue LED: all RBX

once/year
a few times/day (?)

5) Beam on

- in-situ

ECAL+HCAL



Test Beam

Three Goals

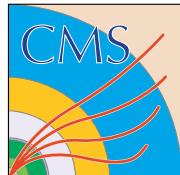
1. Collecting calibration constants
2. Prototype of full system.

→ Establish a complete data flow and coordination among HCAL subgroups

- Operation of hardware
- Analysis of calibration data and creation of calibration constants
- Creation of the calibration database and maintenance
- Interface to ORCA

→ Define/clarify tasks and responsibilities

3. Gain experience



In Situ Calibration (Physics Event Trigger)

A) Min-bias events trigger

- estimation of pile-up energy.
- normalization within each eta-ring.
- isolated low E_T charged tracks



2% accuracy
with 1k events
in HF

B) QCD Jet trigger (pre-scaled)

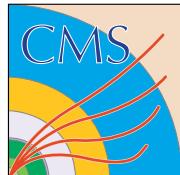
- normalization within each eta-ring
- normalization at the HB-HE-HF boundary
- test on uniformity over full h range.
- dijet balancing to normalize E_T scale in h rings.

C) tau trigger

- isolated high E_T charged tracks ($E_T > 30\text{GeV}$)

D) muon trigger (isolated)

- good for monitoring.
- probably too small energy deposit for calibration.

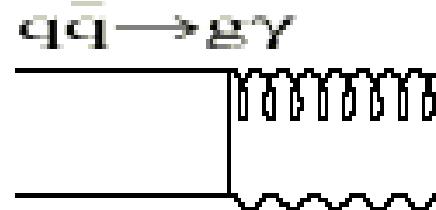


In Situ Calibration (2)

E) 1 photon + 1 jet

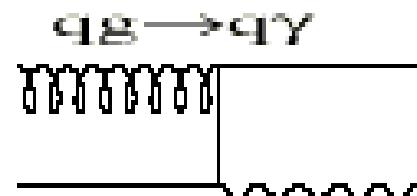
(Victor Konopliniakov)

- E_T Scale over full h range
by photon-jet balancing



F) Z ($\rightarrow ee, \mu\mu$) + 1 jet (...)

- E_T Scale over full h range
by Z-jet balancing



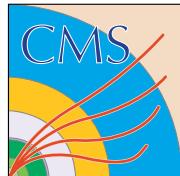
G) Top trigger (1 lepton + jets + 2 b-tags)

- E_T scale by Mass(jj) for W in Top decay.

Not many new results since the HCAL TDR.

E.Dorshkevich,V.Gavrilov (CMS Note 1999/038) E) for HF
Freeman & Wu (Fermilab-TM-1984) F), G)

Need better understanding of trigger requirements and data streaming.



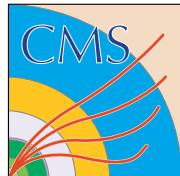
HLT Jets and Energy Corrections

Two steps for HLT jets

- 1) Find jets with $R=0.5 - 1.0$ with fixed calorimeter weights.
- 2) Correct energy scale to sharpen turn on curve.

Energy Correction

- **Jet based**
 - 1) $E = a \times (EC + HC)$, a depends on jet(ET, η)
 - 2) $E = a \times EC + b \times HC$, a, b depend on jet(ET, η)
- **Particle based**
 - 3) $E = em + had$ (requires to separate em/had clusters)
 $em = a \times EC$ for e/ γ
 $had = b \times EC + c \times HC$, for had. b (c) depend on EC (HC)
- **Use of reconstructed tracks**
 - 4) $E = E_0 + (\text{Tracks swept away by } 4T \text{ field})$
 - 5) $E = EC(e/\gamma + \text{neutral}) + HC(\text{neutral}) + \text{Tracks}$



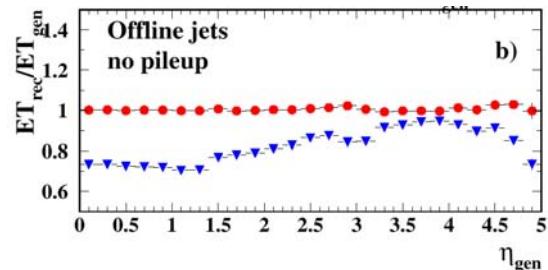
Jet Response and Correction #1

Et-eta dependent correction for QCD jets

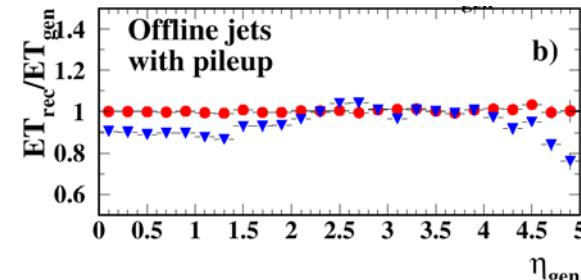
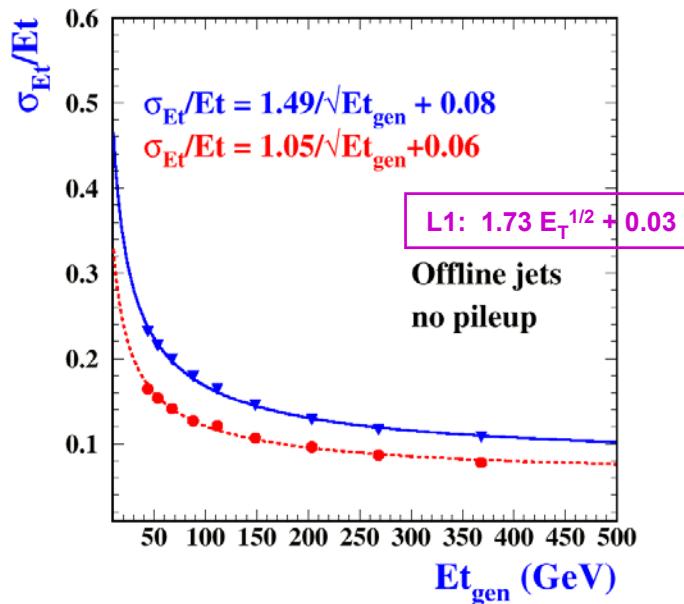
No pileup

$$E_T(\text{corr}) = a + b \times E_T(\text{rec}) + c \times E_T(\text{rec})^2$$

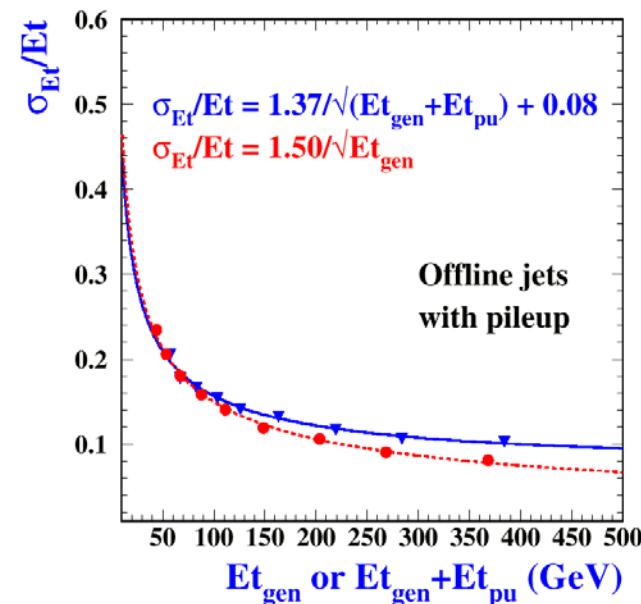
With pileup



Offline Jets resolution, $|\eta| < 5$

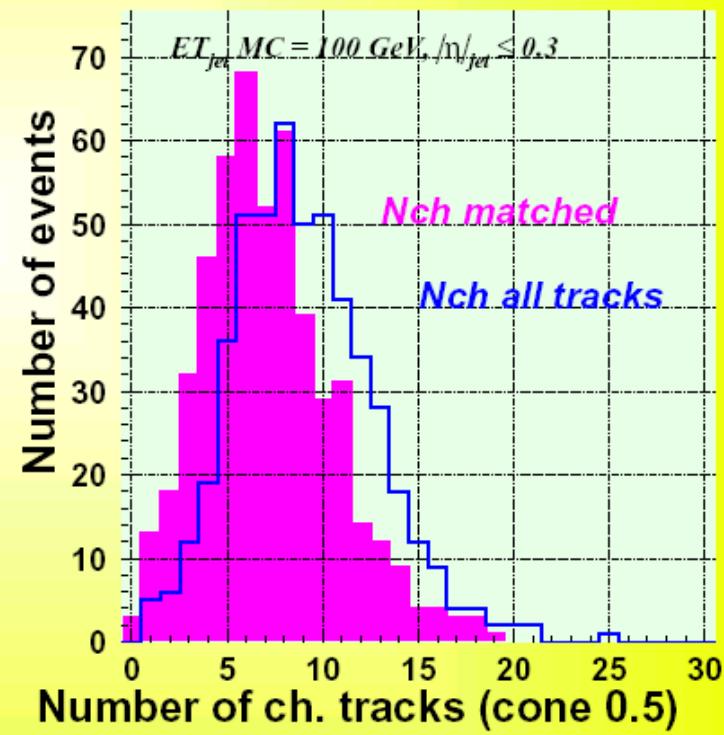
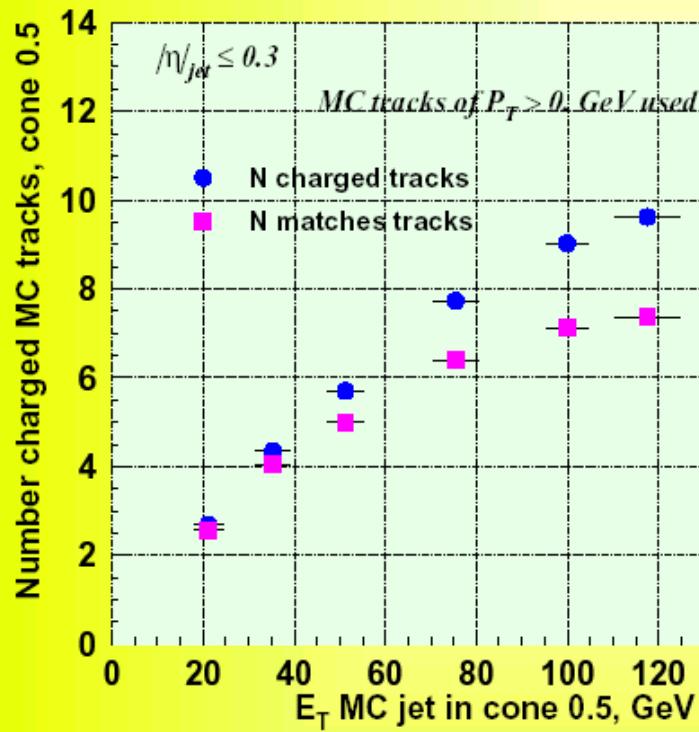


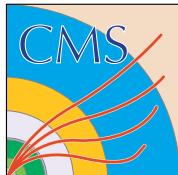
Offline Jets resolution, $|\eta| < 5$



Jet Energy Correction #5 Use of Reconstructed Tracks

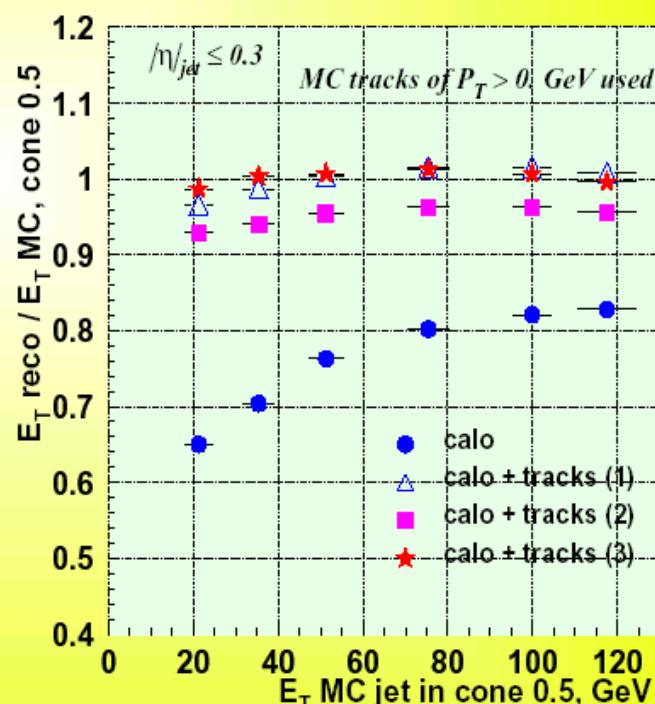
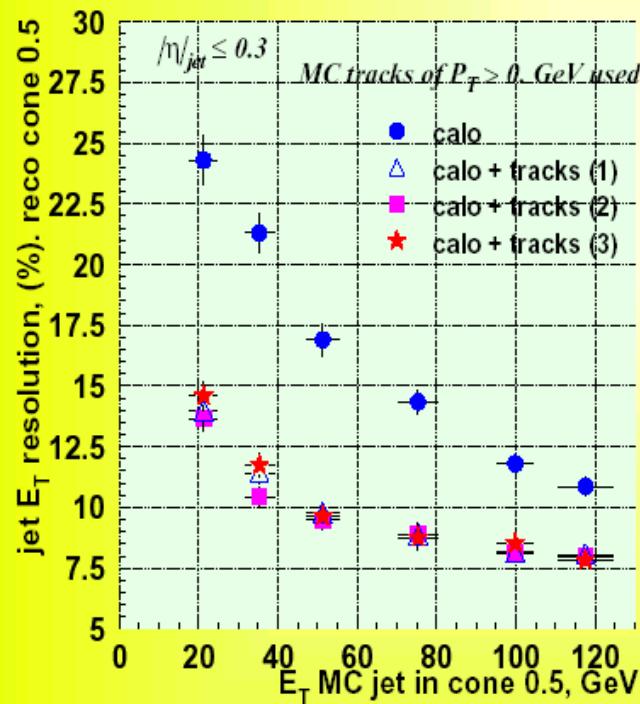
Mean number of all charged particles with hit within reco cone and mean number of particles matched with clusters for different jet energy (left figure). Distribution the number of all charged and charged matched with clusters for jet energy 100 GeV (right figure).



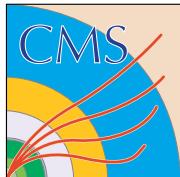


Jet Energy Correction #5 Resolution & Linearity

Window algorithm and algorithm with tracker information. Three options are used for calculating expected response: **e/ π technique (calo+tracks(1))**, **library of responses (calo+tracks (2))**, **matched clusters+library of responses (calo+tracks(3))**



(Irina, Olga + Sasha, Dan)



Summary

Simulation group

- Moving from CMSIM to OSCAR
- Validation

Calibration & Monitoring group

- Collection and maintenance of calib. data
 - Clarify tasks/responsibilities for operation, analysis, collection, maintenance etc.
→ Use test beam as a prototype of full system.
- In-situ calibration
 - Need better understanding of trigger requirements and data streaming.
- Energy scale and resolution
 - 5 levels of jet correction methods have been tried.
 - Method #5 will be implemented in ORCA.
 - Algorithm for event-by-event subtraction of pile-up energy has been (almost) implemented in ORCA.
 - → Those will be tested with some physics channels.